

IC250: Lab assignment 1

HackerRank link: <https://www.hackerrank.com/ic250-lab-1>

1. **Numerical computing: roots of a quadratic equation.** Compute the roots of a quadratic equation of the form

$$ax^2 + bx + c.$$

If you compute the roots in the standard way, the roots may not get computed correctly due to loss of precision. This can happen for example, if a or c are very small. A better way to compute the roots is

$$q \equiv -\frac{1}{2} \left[b + \operatorname{sgn}(b) \sqrt{b^2 - 4ac} \right]$$

and the two roots are

$$x_1 = \frac{q}{a}$$

and

$$x_2 = \frac{c}{q}.$$

For various a , b and c , compare both methods of computing the roots.

2. **Trace of a matrix.** Write a program to compute the trace of a square matrix.
3. **Trace of a matrix (dynamic memory allocation).** Write a program to compute the trace of a square matrix by using dynamic memory allocation.
4. **ADT for vector calculations.** Develop an abstract data type which performs basic operations on vectors in \mathbb{R}^n . The ADT must include functions for
 - Vector creation, returning a vector in \mathbb{R}^n .
 - Vector addition, returning a vector in \mathbb{R}^n .
 - Vector scaling, returning a vector in \mathbb{R}^n .
 - Vector norm, returning a scalar.
 - Checking for vector equality, returning either TRUE or FALSE.

Once the ADT is made, have a `main()` program which creates two vectors, adds them, computes the norm of the second, and scales the sum with the norm of the second. A template is given for reference.

5. **Points inside a circle** Given a set of (x, y) coordinates, and a circle centered at the origin with radius r , determine which of the points are inside the circle.